

REMARKS

Claims 1, 2, 5, 6, 8-10, 19, 21, 22, 24, 27 and 28: Kawakami in view of Eguchi (35 USC 103(a))

The Examiner has rejected independent claim 1 and dependent claims 2, 4-6, 8-10, 19, 21, 22, 24, 27 and 28 under 35 U.S.C. 103(a) as being unpatentable over Kawakami et al. (U.S. 6,683,440) in view of Eguchi (U.S. 5,929,593). The Examiner asserts that Kawakami discloses measurement of battery ohmic resistance (col. 9, lines 36-46) and setting of minimum charging current depending on the battery ohmic resistance (FIG. 6(3)). Applicant respectfully disagrees for reasons including those listed below:

Independent claim 1 and dependent claim 27

As Applicant has previously argued, Kawakami does not disclose measurement of battery *ohmic* resistance. Rather, Kawakami discloses measuring *internal* resistance (col. 9, line 41). Internal resistance of a battery includes many components, including ohmic resistance, chemical resistance, and capacitive and inductive reactance. In the Final Office Action, the Examiner acknowledges that Kawakami discloses measuring internal resistance and does not expressly disclose measuring ohmic resistance. However, the Examiner asserts that Kawakami *implicitly* discloses measuring ohmic resistance because ohmic resistance is a component of internal resistance.

Applicant disagrees. One cannot measure ohmic resistance merely by measuring internal resistance. Rather, to measure ohmic resistance one must measure the component of resistance that is devoid of reactance. The Examiner has not explained why one skilled in the art would be motivated to alter the teachings of Kawakami to separate the ohmic component from the overall measurement of internal resistance. Applicant finds no such motivation in either Kawakami or Eguchi.

To further emphasize this, Claim 27 describes one method of measuring ohmic resistance, as ohmic resistance may be measured as the ratio of a voltage difference to a current difference over a time period between 1 millisecond and 10 milliseconds after current interruption. The Examiner asserts that the elements of claim 27 are disclosed in col. 8, lines 32-65 of Kawakami. However, the Examiner misreads that section of Kawakami. In fact, that section discloses measuring resistance only after the battery reaches a *constant charging value*, not after current interruption. (See col. 8, lines 46-54.) As described in the figures of

Kawakami, constant charging current is not reached for at least *several minutes* after the charging process begins. The Examiner asserts that the time period of claim 27 (1ms – 10ms after interruption) is “an optimum or workable range” associated with the conditions of Kawakami. However, in fact the range of claim 27 would not even yield the same result as (constant charging current value) of Kawakami. Accordingly, claims 1 and 27 are not obvious over Kawakami and Eguchi.

Claim 1 also requires setting a minimum overvoltage protection value. The Examiner acknowledges that Kawakami fails to teach this element. However, the Examiner asserts that Kawakami teaches a different protection (overcharge protection) in FIG. 8, that Eguchi discloses overvoltage protection at col. 6, lines 5-16, and that it would be obvious to substitute the overvoltage protection of Eguchi for the overcharge protection of Kawakami.

Applicant disagrees. The Examiner has not explained what elements in FIG. 8 of Kawakami provide overcharge protection, and Applicant finds no such elements. Applicant requests reconsideration of this rejection.

Dependent claim 2

Claim 2 requires that the overvoltage protection value comprise a difference between maximum voltage and instantaneous open-circuit voltage at terminals of the battery after 1 to 10 ms of current interruption. The Examiner asserts that Eguchi discloses this at col. 8, lines 45-54. Applicant disagrees. Eguchi does disclose having a “predetermined second reference voltage” (col. 6, lines 7-8) that equals an overcharge protection value, but nowhere does Eguchi teach that the second reference voltage should be a difference between maximum voltage and instantaneous open-circuit voltage. Rather, Eguchi teaches that the second reference voltage value should be the sum of open-circuit voltage, plus certain voltage drops across internal resistance referred to as IR loss and IRP loss. (See FIG. 4A of Eguchi). Accordingly, Eguchi teaches the use of an over-voltage value that is much higher than the value required by claim 2.

Dependent claim 5

Claim 5 requires that the constant voltage equal the instantaneous open-circuit voltage. The Examiner asserts that Kawakami discloses this at col. 5, lines 26-36. However,

Applicant does not find this in that passage of Kawakami. In fact, *that passage contains no mention at all of instantaneous open-circuit voltage*. Accordingly, Applicant requests reconsideration of this rejection.

Dependent claim 8

Claim 8 requires that the minimum overvoltage protection be in the range of 0 to 50 mV. The Examiner asserts that this limitation is found in Eguchi at col. 9, lines 35-38. However, Applicant does not find this in that passage of Eguchi. In fact, *that passage describes no specific voltage levels at all*.

Dependent claim 10

Claim 10 requires that the minimum charging current reach a 0.6 – 0.05C rate. The Examiner asserts that this is shown in FIG. 6(1) of Kawakami. However, FIG. 6(1) of Kawakami simply plots a current value over time. It does not disclose any minimum charging current rate.

Dependent claim 19

Claim 19 requires also measuring chemical resistance of the battery. The Examiner asserts that this is disclosed in Kawakami at col. 8, lines 32-65. As noted above in the discussion of ohmic resistance, Kawakami discloses measuring *internal resistance* (col. 9, line 41) and not any individual component of that resistance. Internal resistance of a battery includes many components, including ohmic resistance, chemical resistance, and capacitive and inductive reactance. Kawakami does not teach measuring the specific component that is chemical resistance. In fact, Kawakami does not even mention chemical resistance at all.

Dependent claims 21 and 28

Claim 21 requires determining nonstationary open-circuit voltage as $E_0 = V - I(R_{ohm} + R_{ch})$. The Examiner asserts that Kawakami discloses this at col. 16, lines 37-45. First, that section of Kawakami describes an equation that uses internal resistance $R_{10}(Q)$, and it does not consider only specific components of the resistance. In fact, Kawakami makes no mention of either ohmic resistance or chemical resistance at all. Further, the open circuit voltage $V_{oc}(Q)$ described in that section of Kawakami is not *nonstationary* open-circuit voltage (which is determined during a very brief period after current interruption). Rather, $V_{oc}(Q)$ of Kawakami refers to reversible open-circuit voltage, which is determined during a much longer period of

constant current interruption. Reversible open-circuit voltage is always much lower than instantaneous, nonstationary open-circuit voltage.

Dependent claim 22

Claim 22 requires that nonstationary open-circuit voltage be used to recognize battery state-of-charge. The Examiner states that this is disclosed in FIG. 1, steps 10 and 11 of Kawakami. Applicant disagrees. Step 10 describes determining a state of charge, but there is no teaching that nonstationary open-circuit voltage should be used to make the determination. Step 11 describes using open-circuit voltage, but not for determining state-of-charge. Rather, Step 11 describes using open-circuit voltage to determine an internal battery resistance measurement. In addition, later in the application (FIGs. 10 and 11), Kawakami discloses using reversible open-circuit voltage for a state of charge determination but Kawakami does not suggest using the much higher nonstationary open-circuit voltage level for this purpose.

Claims 3, 4 and 7: Kawakami in view of Eguchi and Ostergaard(35 USC 103(a))

The Examiner has rejected dependent claims 3, 4 and 7 under 35 U.S.C. 103(a) as being unpatentable over Kawakami in view of Eguchi and further in view of Ostergaard (U.S. 5,994,878). Applicant respectfully disagrees for reasons including those listed below:

Dependent claim 3

The Examiner asserts that Ostergaard discloses choosing a minimum charging current as a ratio of the minimum overvoltage protection value to the battery ohmic resistance. Applicant disagrees. That section refers to *total voltage drop* over *multiple* batteries, not a minimum overvoltage protection value for any particular battery. Further, there is no mention of using the ohmic component of resistance for any measurement.

Dependent claim 7

Dependent claim 7 requires that the constant voltage equal maximum voltage plus a product of the minimum charging current and the ohmic resistance. As noted above, none of Kawakami, Eguchi or Ostergaard make any mention of using the ohmic component of resistance for any purpose.

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CONCLUSION

Based on the arguments and amendments set forth above, applicant respectfully requests that the Examiner reconsider the rejections in this application. If the Examiner believes that any particular amendment would facilitate allowance or advance prosecution, we request that the Examiner issue an Advisory Action or contact the undersigned attorney James M. Singer at telephone number 412.454.5023.

The Commissioner is hereby authorized to charge any additional fees which may be required for this submission, or credit any overpayment, to Deposit Account No. 50-0436.

Respectfully submitted,

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